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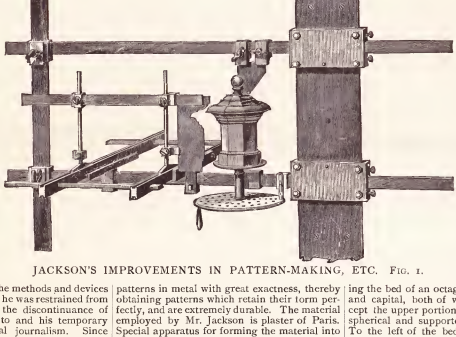
Jackson's Improvements in Pattern-Making and Casting Metals.

NO. 1.

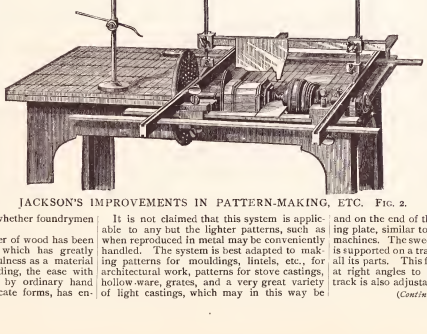
In 1874 the writer of this article was called upon to examine into the merits of some improvements in pattern making and casting of metals, the inventor of which is Mr. J. L. Jackson, whose extensive works are situated on Twenty-eighth Street, between First and Second Avenues, New York City. This investigation clearly demonstrated that very important advantages are secured by the improvements, which were then just patented, very broad and comprehensive claims having been allowed. As the outcome of this examination, in which the fullest scrutiny was invited, and which occupied several days of inspection of processes and apparatus employed, a series of articles with elaborate engravings were prepared for a then prominent technical periodical, the publication of which has been since discontinued. It was the intention of the writer at that time to subsequently pursue the subject, and urge the general adoption of the methods and devices under consideration, but he was restrained from fulfilling his purpose by the discontinuance of the publication referred to and his temporary diversion from technical journalism. Since that time these improvements have been on trial at Mr. Jackson's works, and have resulted in a large saving of skilled labor in the making of patterns, and have rendered possible the easy and certain production of castings which, before the invention, were extremely difficult to make.



JACKSON'S IMPROVEMENTS IN PATTERN-MAKING, ETC. FIG. 1.

These facts justify us in bringing the subject again before the public. As our space is too limited to admit an extended and exhaustive discussion, we must content ourselves with presenting only the main features of the inventions to the attention of our readers, and we confidently assert that, purely as a matter of study, the subject cannot fail to be improving and interesting to all mechanical readers, whether foundrymen or not.

The hygroscopic character of wood has been a long recognized defect which has greatly lessened its value and usefulness as a material for patterns. Notwithstanding, the ease with which it may be worked by ordinary hand tools, and carved into intricate forms, has enabled it for a long period to hold its place. Mr. Jackson has, however, successfully solved the problem of making a great variety of patterns for architectural purposes, machinery, gearing, stoves and ranges, and for other purposes, at a much cheaper rate, and of much more perfect character than they can possibly be made from wood, and he reproduces these patterns in metal with great exactness, thereby obtaining patterns which retain their form perfectly, and are extremely durable. The material employed by Mr. Jackson is plaster of Paris. Special apparatus for forming the material into patterns is employed, the accompanying engravings illustrating some of these appliances.



JACKSON'S IMPROVEMENTS IN PATTERN-MAKING, ETC. FIG. 2.

It is not claimed that this system is applicable to any but the lighter patterns, such as when reproduced in metal may be conveniently handled. The system is best adapted to making patterns for mouldings, lintels, etc., for architectural work, patterns for stove castings, hollow-ware, grates, and a very great variety of light castings, which may in this way be manufactured cheaper and far more perfect than is possible by the use of wood patterns. Patterns of plaster are not new, and only in the method and means employed consists the merit and novelty of this invention

A good understanding of the system may be obtained from special examples illustrated in the engravings and hereinafter described.

In Fig. 1 is shown the apparatus as arranged in a vertical position for making a pattern. This position is not, however, essential. It may be used either in a horizontal or inclined position, as occasion requires. The machine consists of three rectangular bars, coupled together, the couplings and the bars being so accurately fitted that they form an exact rectangle when attached to a supporting post. The couplings which attach the bars to the supporting post are adjustable towards or from each other, or up and down on the post, according as circumstances may require. The bar represented in vertical position in Fig. 1 is also adjustable on the horizontal bars.

The machine is shown in Fig. 1, as it is arranged for forming the bed of an octagonal pattern with a base and capital, both of which are octagonal, except the upper portion of the capital, which is spherical and supported by a cylindrical neck. To the left of the bed, which is shown completed, is delineated a sweep having an edge properly shaped, and by which each side of the octagonal bed is formed. At the top, just above and to the right of the bed, and supported by the upper horizontal bar, is shown the sweep by which the sphere and the cylindrical neck which supports it are formed. This sweep is attached to a horizontal bar clamped to uprights, the bases of which slide in ways placed at right angles to the lower horizontal bar. The bed rests upon a face-plate precisely similar to that used in a lathe. The spindle which supports this plate passes through a bearing in a head which is adjustable on the bar which supports it. Below this bearing, and on the end of the spindle is placed a dividing plate, similar to that used in gear-cutting machines. The sweep to the left of the pattern is supported on a travelling frame adjustable in all its parts. This frame slides in ways placed at right angles to the supporting bar. This track is also adjustable to any required width.

(*Continued on page* 88.)

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CONTENTS, April 15, 1879.

Jackson's Improvements in Pattern-making and Casting Metals 85, 86, 87
Announcements 86
Central Park not a Fit Site for an International Exhibition 86
Mystery of the Long Screw-Driver. 86
A Word of Apology 86
Elevated Railway Noises 87
Rents on Broadway 87
How Much is a Billion? 87
London versus New York 87
Sound and the Phonograph 87
Probable Cause of Leprosy 87
Transportation of Coal at Pittsburg 87
Fire-proof Timber for Mines 87
Primitive Iron Manufacture in Africa 87
Intellect in Brutes 89
Norcross Damper Regulator 89
Penguins at Home 90
McVeen's Patent Horseshoe 90
Dodge's Stone and Ore Crusher 90
Chasers 91
Mutual Relations of Capital and Labor 91
Progress in Sciences and Arts 92
The Sea-Sickness 92
Shop and House Hints 93
Patents Granted March 11th and 18th, 1879. ...93, 94, 95

Calling the attention of our readers to the advertisement of our Patent Department, which appears among other advertising in the present number, we desire to say that we shall be happy to correspond or to consult with inventors or others interested in new inventions relative to any matter connected with the procuring of patents, the validity of patents already obtained, reissues, interferences, trade-marks, caveats, etc., and to make preliminary examinations when desired. All communications and consultations are held to be strictly confidential.

An error in the name of the inventor of the sliding railway system occurred in our article upon the subject published in our last issue. Instead of "E. W. Pitman," it should have been "G. W. Pitman." Mr. Pitman will please accept our apologies.

We continue the publication of the lists of patents as issued in this number, but adopt a different form. The names of the patentees are given alphabetically. The date of the patents in each list is given at the head of the list, and the number of each follows the title of the patent. This is a very convenient arrangement for reference. In ordering patents from the lists, the name of the inventor, title, date, and number of the patent should be given.

In this number we commence the publication of a column of advertising under the title of "Business Hints." It is intended for the accommodation of advertisements of a brief character (which would not be conspicuous if distributed among larger advertisements), for business cards, short announcements, etc. Advertisers occupying larger space in our general advertising columns will find it to their interest also to insert their business cards under this heading.

Central Park Not a Fit Site for an International Exhibition.

At an enormous expense of money under the guidance of artistic genius and through the fostering care of conscientious officials and public-spirited citizens, Central Park has come to be not only the pride of the American metropolis, but it is world-renowned for its beauty. No spot can be found on this continent where art and nature more combine to gratify the highest tastes of a civilized people and where at the same time everything calculated to detract from these salutary influences is more scrupulously excluded. No lover of his kind can visit this modern Eden, whose gates open alike to rich and poor, without a feeling of admiration for the true benevolence of its projectors through whose efforts a delightful escape from heat, dust, noise and moral impurity, has been provided for the population of New York.

Entertaining as we do this sentiment, and speaking in the interest of this noble pleasure-ground from thorough knowledge partially acquired through former experience as President of the Board of Park Commissioners, we most earnestly protest against its use or the use of any part of it for any other purposes than were contemplated in its original plan.

We object because the park has not one acre more than is necessary to fulfil these purposes. We object because if any encroachment is permitted it forms a precedent for another. We object because an international exhibition would draw to it a concourse of people from all parts of the world, who, feeling no direct interest in the preservation of the beauties of the park, will be found comparatively uncontrollable by any police force which can be stationed there to guard them. We object because a very large expenditure of money devoted to the adornment of this beautiful resort would be sacrificed, and a reconstruction of whatever part of the grounds may be taken for the exhibition would become imperatively necessary, if indeed buildings, once erected, would not be allowed to remain at the permanent sacrifice of natural beauty.

These remarks are called for by the fact that a committee appointed to select a site have fixed upon a part of the park as an appropriate location.

We believe that equally good and available locations may be obtained without encroaching upon the park. In a letter addressed to the New York *Herald*, dated April 2d, and published in the issue of that paper for April 3d, the senior editor of the Scientific News made a suggestion for a site which has points in its favor, among which is its great accessibility. It could be directly reached by boats on the North River, by the Hudson River Railroad, and by the Metropolitan Elevated Railroad. The Eighth Avenue Railroad passes the site and an easily-constructed cross-town line could be made to connect it with all the east side lines of steam and horse railroads, and with the East River.

We close this article with the following quotation from the letter referred to:

"This great pleasure ground was appropriated as a breathing-place for the people, and it was never intended to be used for any other purpose. For years past the tendency has been to get possession of some of the finest portions of the park and divert them to purposes entirely foreign to the original object, and scarcely a year passes that some effort is not made to gain a foothold in the park for parade grounds, music halls, art galleries, and other shows which have no business there. The people should most earnestly protest against the proposed diversion of any part of the park for the coming exposition It would destroy some of its most lovely features, and, as you very justly say, the buildings, once placed there, would remain for years an eyesore and an offence. I hope the Commissioners of Parks will never consent to this proposition. I would suggest that the public spirited committee having this matter in hand, examine the tract of comparatively unoccupied property north of 110th Street, including the Morning-Side Park, and running up in the line of Eighth Avenue to 125th Street. I think enough ground could be secured in this section of the city for the proposed exposition, and at a very small compensation for its use to the private owners. At any rate, and in common with many others, I do most earnestly object to the desecration of the Central Park for this or any other exhibition. The people must be vigilant against these encroachments upon their health-giving privileges, or they are liable to lose them altogether."

The Mystery of the Long Screw-Driver.

"What is the reason a screw can be driven home by a long screw-driver, when it cannot be put in by a short one?" Thus asks one of the readers of the Scientific News. The implied assertion of fact involved in the question is generally admitted by men who use screw-drivers most, but it is often denied by theoretical men. *Is it a fact?* We answer yes. We proved it to be a fact twenty years ago as follows:

We took a piece of cherry scantling well seasoned—a very homogeneous, hard piece of timber. In it we bored a number of holes with the same bit, all piercing the grain of the wood in the same direction, and all deeper than the length of the screws to be inserted. The screws were carefully calliperd to get them of the same size, and were of the same length. The holes were reamed out to a uniform depth by gauge to receive the unthreaded parts of the screws. The screws were long, so as to give a considerable increase of friction as they entered the wood. All the holes were accurately countersunk to receive the heads of the screws. By several trials a bit was selected that caused the increase of friction to prevent the entire insertion of the screws with all the power that could be applied by means of a round shanked screw-driver the total length of which was ten inches, the handle being five inches in length and detachable.

The same handle was fitted to another screw-driver very much longer than the first, made of the strength and the same in every dimension except length. With this screw-driver the screws could all be driven home after they were so firmly "stuck in the holes" that the short screw-driver would turn them no further.

A second experiment was the attempt to extract the screws with the short screw-driver. We found it impossible to start them with all the strength we had exerted, but we took them all out with the long screw-driver. Thus the fact of the greater capacity of the long screw-driver was established.

Next we set about finding the reason for the fact. Mere increase of length seemed inadequate as a cause, and after considerable thinking we struck upon the following theory, the truth of which we also established by experiment before we quitted the investigation.

A certain amount of inclination from the perpendicular axis of the screw probably always occurs in the effort to put in a screw with a screw-driver. The angle of this inclination is limited, for if a certain angle is exceeded, the point of the screw-driver is disengaged from the nick in the head of the screw. This angle is the same no matter what may be the length of the implement.

The effect of this inclination is to cause the handle of the screw-driver to traverse a circle described around the central vertical axis of the screw, and a leverage is thereby acquired considerably greater than what is due to the diameter of the handle. Now the distance to which the handle may be carried away from the central axis without releasing the tool from engagement with the nick of the screw will be greater with the longer screw-driver. A crank-like action is produced by this deviation from the central axis which is greater with the longer screw-driver.

We proved this by arranging a guide over the screws in our experiment, through which guide the screw-drivers were successively passed in such manner that any deviation from the vertical axes of the screws was prevented. Under this condition we could neither put in nor take out the screws, with either the short or the long screw-driver.

A Word of Apology.

Some subjects discussed in this number absorb rather more of our space than is in accordance with the general plan upon which we conduct the Scientific News. Occasionally, however, we are forced, on account of their interest and importance, to admit discussions of greater length than that to which we ordinarily intend to limit our articles. Generally we do not desire to continue a discussion or essay beyond a single number. We have, however, in this number departed from this rule in two instances. The series of articles which we now

begin, entitled "The Mutual Relations of Capital and Labor," is a most able and statesmanlike essay, which is entirely free from objectionable, visionary, or radical views, and which, in our judgment, clearly points out the way in which labor and capital may and must ultimately adjust their differences, and meet on a common ground of justice and equity. We make place for the republication of this paper in installments, first, because the subject is of infinite importance to both capital and labor, and second, because in the entire range of our reading upon the subject, we have not found compressed within so small a compass so comprehensive and clear an expression of the true principles upon which modern civilization progresses. We cannot too earnestly commend to our readers the sober, careful perusal of this essay.

The illustrated description of Mr. J. L. Jackson's improvements in pattern-making and casting metals is, also, though somewhat extended, an interesting and instructive article. It necessarily will extend to at least another number, but will, we believe, prove acceptable to our readers, notwithstanding its length.

The Elevated Railroad Noises to the Front Again.

MR. ROOSEVELT ON EEL SKINNING—WHY RENTS ARE LOW ON BROADWAY—HOW MUCH IS A BILLION?—LONDON VERSUS NEW YORK—SOUND AND THE PHONOGRAPH.

AT the meeting of the Polytechnic Association on Thursday, 20th ult., the subject of the elevated railroad noises, for some time defunct, was resuscitated. The president, Dr. J. V. C. Smith, thought it among the strange things that of all the numerous devices, plans, propositions made, patents taken out, and so forth, for abating or killing these noises, not one should have been adopted. Nothing has come of all the ingenuity expended in that direction. People, moreover, have come now not to care about those noises. They are so used to them they do not mind them. Even the horses have become callous to them. It was truly wonderful, this law of adaptation to circumstances.

Mr. Roosevelt is a walking repository of anecdote, and here was an opportunity not to be resisted. He was reminded, he said, of a woman who was once charged with cruelty for skinning eels. She replied that she was not cruel; that she skinned so many of them they were used to it, and did not feel it. (Laughter.)

Mr. Sutton was sure there was no more of a noise along the elevated raliroads than was made every day past his office window on Broadway. *Ergo*, the people along the routes of those railroads could suffer no extraordinary grievance. The noise, too, in his opinion, was innocent of any depressing influence on rents. If rents fell, in other words, the elevated railroads were not responsible. For instance, rents had fallen so low even on Broadway that he had three rooms there near Canal Street at $30 a month. Then he pointed to vacant houses and vacant apartments on either side of him, whereupon somebody got off the wicked joke that perhaps they were vacant on account of his proximity to them. The countenances of the sages here relaxed.

The president next piloted the Polytechnicians into the region of railroad statistics, and fairly overwhelmed his hearers by the immensity of the figures he flung out. Among these, not the least amazing item was that the united capital invested in all the railways of the world amounted to 15 billions, 500,000 millions of dollars.* The reflection made by the president at the heel of all these immensities was the natural enough one that "such was the ingenuity of man! And all this was brought about by steam power."

Prof. Dunn followed with a retrospective glance at the progress of steam power. The great problem to be solved once in England, said he, was how to transport coal from one place to another. After many days a crazy man appeared, by name Stephenson. He insisted that steam could be made to draw coal better than horses, but no one listened. He was met with the query, thought then to be unanswerable, "How can you ever by such means get wheels to start or move on rails?" Still Stephenson insisted the thing could be done. He went to work and made a machine that went five miles an hour. It was thought that was the greatest speed that could ever be attained. From that humble beginning have come those 15½ billions of dollars invested in railroads.

As statistics were in order, the president put London against New York in a pair of scales, as it were, to test their relative weights in regard to area, population, etc. Of course the scale loaded with London greatly preponderated, but the president, with prophetic eye, declared that 200 years hence New York would make her English antagonist kick the beam.

Next came *the* piece of the evening, namely, a lecture on sound, with experiments and an exhibition of the phonograph by Master W. E. Gibbs, a prodigy from the Stevens Institute of Technology in Hoboken. This young gentleman, who is hardly yet out of his teens, handled his apparatus (all of his own construction) with a dexterity and explained the principles of sound with a lucidity that entitle him to be called "the boy Tyndall." He showed by a simple contrivance of his own how to calculate the number of vibrations corresponding to any given sonorous note; how the most delicate variations of the human voice can be visibly depicted by a bizarre band of light in a mirror, with many other interesting if not quite novel experiments, winding up with an exhibition of a home-made phonograph manufactured by himself at a cost not exceeding a dollar and a half. The novel feature of this phonograph was that the cylinder was made of plaster of Paris on an iron shaft, and the mouthpiece was cut from a board with a penknife. He put the instrument through the usual drill of repeating nursery rhymes, etc., and it did its work admirably. The hoary sages looked on in wonderment at a mere boy who showed them many things some of them never knew.

* Dr. Smith's notion of a billion must be the old, often questioned, and now nearly discarded one that it is a million of millions. A billion is now commonly understood to mean a thousand millions.

Probable Cause of Leprosy.

A PROBABLE cause of leprosy, a disease both the cause and remedy of which have hitherto eluded discovery, has been pointed out by Mr. Manson in a communication to the Linnean Society. Microscopists have discovered in human blood and in the blood of dogs, swarms of small thread-like worms—*Filaria sanguinis hominis*. If they could grow and breed in the body in which they first appear, that body would soon die. "If the brood of embryo *Filariæ* at any one time free in the blood of a dog moderately well charged with them, were to begin growing before they had each attained a hundredth part of the size of the mature *Filaria*, their aggregate volume would occupy a bulk many times greater than the dog itself. I have calculated," says Mr. Manson, author of the paper in question, "that in the blood of certain dogs and men there exist at any given moment more than two millions of embryos." This minute creature is a very formidable parasite. Were it not that large numbers disintegrate and perish, or are voided with the secretions, having even been found in the tears, the natural function of the blood would be impossible. Nature requires that for further development the *Filaria* as well as other parasites should enter some other body. Knowing that mosquitoes suck human blood, Mr. Manson made arrangements by which he captured a number of the insects which had gorged themselves on the blood of a filarious Chinaman who had been "persuaded" to sleep in a mosquito chamber. On examining the insects by aid of the microscope, the subsequent development of the *Filaria* could be well made out: it passes through three stages, in the last of which "it becomes endowed with marvellous power and activity. It rushes about the field (of the microscope), forcing obstacles aside, moving indifferently at either end, and appears quite at home." Referring to the papillæ which, appearing at one extremity of the creature, are supposed to be the boring apparatus, Mr. Manson says: "Tbis formidable-looking animal is undoubtedly the *Filaria sanguinis hominis* equipped for independent life, and ready to quit its nurse, the mosquito." The *Filaria* "escaping into the water in which the mosquito died is, through the medium of this fluid, brought into contact with the tissues of man, and either piercing the integuments, or what is more probable, being swallowed, it works its way through the alimentary canal to its final resting-place. Arrived there, its development is perfected, fecundation is effected, and finally the embryo *Filariæ* we meet with in the blood are discharged in successive swarms and in countless numbers. In warm climates the presence of these microscopic worms is most to be feared; and it has been but too clearly made out, and that its presence is associated with painful and disgusting diseases, and "not improbably with leprosy itself."

Transportation of Coal at Pittsburgh.

THE *Louisville Commercial* states some interesting facts relative to the shipping of coal from Pittsburgh to more southern cities, which will probably be new to most of our readers.

"In Pittsburgh and vicinity there are 50 operators or firms engaged in the coal business; about one half of whom sell at the mines, the other half are shippers engaged in running coal to Southern ports. The shipments for Southern consumption from Pittsburgh amount annually, on an average, to 80,000,000 bushels of coal and 20,000,000 of coke, which is sent south by the shippers on the tides as they occur. For this purpose they employ 96 tugs or tow boats, and about 1500 barges and shells, in which the coal is transported. Each barge costs about $1000 and carries from 12,000 to 13,000 bushels. The shells cost about $500, and they carry about 24,000 bushels. The barges, when unloaded at their destination, are returned to the mines; the shells are generally sold in the South, and broken up for other uses by the purchasers.

"On an average there are ten coal tides or rises at Pittsburgh during the year, which occur suddenly, and frequently last only from 24 to 36 hours. The barges and shells must, therefore, be kept loaded and ready for departure at an hour's notice. When the opportunity arrives, the tows are lashed to the tugs, each taking about 10 barges, containing, say, 150,000 bushels of coal, the great length of the tows, and the short time allowed by the rapidly-falling river requiring the most expeditious movements.

"By this admirable barge system coal is kept at a price but little above that of Pittsburgh to the cities above the falls of the Ohio, the expenses of running the coal to Louisville, including the cost of returning the barges to the mines, being only about 1½ cents per bushel."

In commenting on this statement, the *Engineering and Mining Journal* says "that Pittsburgh coal thus receives what is probably the cheapest freight transport in the world—so cheap, indeed, that the railroads through the coal regions of Ohio and Kentucky cannot compete with Pittsburgh for the supply of the River towns, even when comparatively near by."

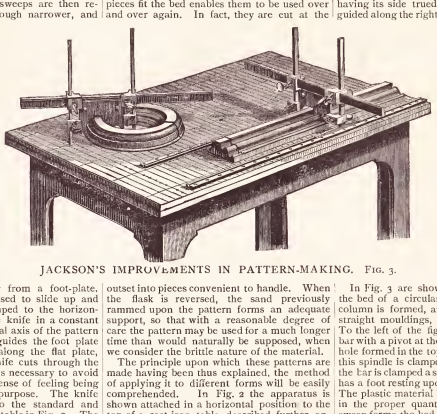
Fire-Proof Timber for Mines.

MR. D. R. GARDNER, of Glasgow, claims to strengthen, harden, densify, season timber and preserve it against decay and from the attack of worms and insects. He dissolves and removes the sap by placing the timber in a tank and subjecting it to the action of neutral vapor, or to alkaline vapor, or to acid vapor, separately or combined, and in any order, and the process may be carried on continuously or intermittently from about 60 hours to 84 hours. He begins with neutral vapor, then alkaline vapor, then acid vapor, then neutral vapor or fumes of mercury; the time may be 24 hours for each of the first three steps, and 12 hours for the last, which should be the fumes of a mercury salt, if for preservation. The alkali and acid may be applied by being put into the boiler or otherwise, and the vapors can be tested by litmus paper. The mercurial fumes are obtained by mixing equal quantities by weight of mercury and nitric acid.

For extreme cases, where timber is wanted to stand against active decay, insects, seaworms, or made non-inflammable, it is only necessary to allow it to absorb any effectual preservative poison or non-inflammable solution or fumes after the first process; if in a solution when the timber is dense and bulky, the solution can be heated and cooled till it penetrates, or a vacuum may be created, after which pressure may or may not be used to force the solution in. When the timber is to be exposed to the action of the weather or water, the preservative poison or non-inflammable chemical after having gone into the timber, either in solution or in fumes, is made insoluble by an affinity of a reagent for the chemical or chemicals employed.

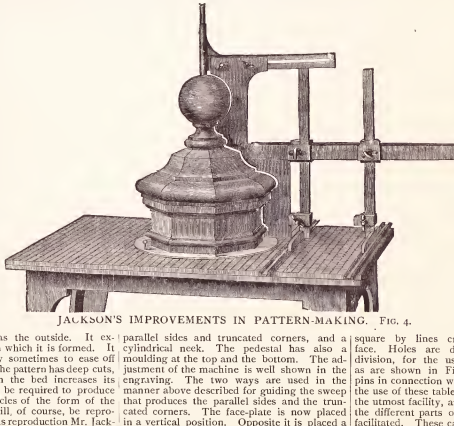
(*Continued from page 85.*)

The method of forming the bed is then as follows: The plastic material having been placed upon the face-plate, the sweep to the left is adjusted to the proper distance from the centre, and the first sweep made. By means of the dividing plate, the face-plate and the plastic material are then turned horizontally one eighth of a revolution. The second sweep is then made, and so on until the eight sides are formed. During this process the sweep supported by the upper bar will have formed the cylindrical neck and the sphere at the top of the capital. This completes the bed. The sweeps are then replaced by other ones, enough narrower, and having the proper contour of edge, to give the required thickness and shape to the pattern which is now to be formed upon the bed. The bed is then coated with some material which will prevent the coherence of the new plastic material which is to be placed upon its exterior surface. A sufficient quantity of this plastic material is then placed upon the surface of the bed, and it is swept precisely as before. The frame which supports the sweep at the left and the ways are then removed. A flat plate is then clamped to the horizontal bars in a vertical position. A knife with a very thin point is then adjusted to a rod rising from a foot-plate, the base of which is caused to slide up and down the flat plate clamped to the horizontal bars. This keeps the knife in a constant line with the central vertical axis of the pattern bed. The operator then guides the foot plate which sustains the knife along the flat plate, until the point of the knife cuts through the pattern. Very little care is necessary to avoid cutting into the bed, the sense of feeling being a sufficient guide for this purpose. The knife used is shown attached to the standard and foot-plate resting upon the table in Fig. 2. The pattern is thus divided vertically at one of its angles. The dividing-plate is then rotated half a revolution, and the pattern is divided on the opposite side in the same manner. The two counterparts are then removed, and the work is done. The knife used for this cutting is extremely thin, nevertheless it removes from the pattern a portion equal to its thickness. This is restored by spreading some thin plaster upon a flat surface and laying the pattern on it. In ordinary summer weather the patterns will dry sufficiently quick without any artificial heat. In cold, damp weather it requires a moderate heat to dry them, say about ninety degrees. The only point in the whole operation that requires much care is the removal of the pattern from the bed. It will be seen that the inside of the pattern must be as accurate as the outside. It exactly fits the bed upon which it is formed. It is, however, necessary sometimes to ease off the bed slightly, when the pattern has deep cuts, as the varnish used on the bed increases its size a very little. If it be required to produce a large number of articles of the form of the pattern, the pattern will, of course, be reproduced in metal. In this reproduction Mr. Jackson employs a system alluded to above as belonging to a second class of improvements which will be described in a future issue. It will suffice to say here, that the method enables him to make the metal patterns with surprising accuracy. Practically, they are *fac-similes* of the plaster patterns, the usual differences arising from the shrinkage of metals, springing of castings during the process of cooling, etc., being almost wholly avoided. If, however, only a few articles are required, the plaster pattern and its bed are used directly in moulding. The board upon which the bed rests being accurately trued up, and the bed placed firmly upon it, the accuracy with which the plaster pattern, however thin, fits the bed, enables the sand to be rammed down upon it to the required compactness. The patterns often break, but even when broken, the accuracy with which the pieces fit the bed enables them to be used over and over again. In fact, they are cut at the outset into pieces convenient to handle. When the flask is reversed, the sand previously rammed upon the pattern forms an adequate support, so that with a reasonable degree of care the pattern may be used for a much longer time than would naturally be supposed, when we consider the brittle nature of the material.



JACKSON'S IMPROVEMENTS IN PATTERN-MAKING. FIG. 3.

The principle upon which these patterns are made having been thus explained, the method of applying it to different forms will be easily comprehended. In Fig. 2 the apparatus is shown attached in a horizontal position to the top of a cast-iron table, described further on. It is shown in the process of forming the bed of a vase, the principal part of which is oval in plan, and which has an oblong pedestal with parallel sides and truncated corners, and a cylindrical neck. The pedestal has also a moulding at the top and the bottom. The adjustment of the machine is well shown in the engraving. The two ways are used in the manner above described for guiding the sweep that produces the parallel sides and the truncated corners. The face-plate is now placed in a vertical position. Opposite it is placed a puppet-head which carries a centre precisely similar to that used in a lathe. This centre serves to support the end of a mandrel, the front end being supported by the face-plate. Upon this mandrel the plastic material is built up until a sufficient mass is formed. The sweep is then used, the division plate enabling the operator to revolve the face-plate and spindle, with the plastic material thereon, to just the proper position for forming the sides and truncated corners. When this has been done, the pattern-bed has been caused to make an entire revolution, and the horizontal sweep shown in the engraving will have then formed the cylindrical neck. To form the oval or ellipse, an elliptical pattern, previously placed on the spindle, revolves with it. A sweep with the required contour of edge to form the moulding, etc., upon the elliptical form, and having its side trued up exactly, so as to be guided along the right-hand parallel bar, is then employed. A portion of the sweep rests against the elliptical pattern, and is kept in contact with it by the hands of the operator. The plastic material being then revolved, of course an elliptical form is the result. With very little practise this may be accomplished, even by unskilled hands, with great accuracy. Upon a visit to Messrs. Jackson's works, we were once much surprised to find two boys, the eldest of whom did not appear to be over seventeen years of age, making quite complicated patterns, the adjustment of the apparatus having been previously made by a skilled workman.



JACKSON'S IMPROVEMENTS IN PATTERN-MAKING. FIG. 4.

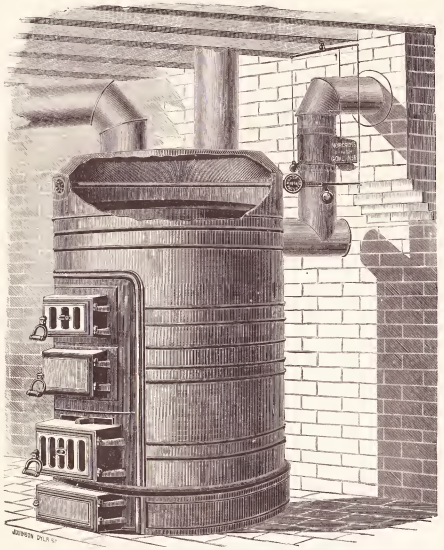
In Fig. 3 are shown the methods by which the bed of a circular moulding or base of a column is formed, and also the way in which straight mouldings, cornices, etc., are made. To the left of the figure is shown an upright bar with a pivot at the bottom, which works in a hole formed in the top of a cast-iron table. To this spindle is clamped a horizontal bar, and to the bar is clamped a sweep and an upright which has a foot resting upon the surface of the table. The plastic material being laid upon the table in the proper quantity, the revolution of the sweep forms the bed. This is precisely the apparatus shown in Figs. 1 and 2, minus the parallel ways, and having the upright bar with a pivot at bottom instead of a foot. Upon the right of the figure is shown two parallel ways fastened to the top of the table. In these ways slide the bases of two parallel uprights, which are kept in a parallel position with each other by means of a horizontal bar clamped to them. To this bar is clamped the sweep. The bed of the pattern is shown as having been previously formed, and the apparatus is shown in the act of forming the pattern upon the bed.

In Figs. 2 and 3 is shown a peculiar form of cast-iron table, employed in connection with the apparatus as above described. These tables have their surfaces planed up true, and are then divided in the most accurate manner into spaces of one inch square by lines crossing their upper surface. Holes are drilled at the points of division, for the use of pivoted bars, such as are shown in Fig. 3, and for the use of pins in connection with the dividing-plate. By the use of these tables distances are set off with the utmost facility, and the parallel setting of the different parts of the machine is greatly facilitated. These cast-iron plates placed upon strong iron framework, have the advantage that they always remain exactly level, not being influenced by moisture, which will more or less affect the truth of a wooden surface. These tables are much more expensive than wooden tables, but their advantages much more

than compensate for their increased cost. They are not, however, considered essential to the use of the apparatus. Very good work indeed may be done upon wooden tables of quite cheap construction.

Fig. 4 shows an apparatus to be used in connection with the parallel ways and a cast-iron table. The dividing-plate is shown in this figure at the bottom of the spindle. The divisions are obtained by holes in the plate, through which a pin is thrust which passes into a hole in the top of the table. A horizontal revolving arm is attached to the spindle. This is used for forming the capitals of columns, posts, etc., in which a combination of the cylindrical with the hexagonal, octagonal, or other angular forms is required. In this case the pattern-bed is revolved by means of the division-plate, which is also in this case the face-plate. In order to form parallel sides, a sweep is made to pass over the surface of the pattern-bed, as shown. When this has been done, the horizontal bar at the top is caused to revolve, and its sweep is carried about, forming the cylindrical and spherical portions at the top. It can readily be seen that, according to the number and position of holes in the plate, any angular form can be made without any change in the adjustment of the apparatus.

PRIMITIVE IRON MANUFACTURE IN AFRICA.—Dr. Arthur Mitchell, in delivering the Rhind lectures on Archæology in Edinburgh, chose as his subject for one "The Iron Age Savage." He described the negro tribes of the heart of Africa as having reached an iron age without having passed through an age of stone, and there was just as little evidence of their having passed through a bronze age, though copper was one of the few metals which were worked by them. It would be quite a mistake to conclude from the fact that the Central African tribes were acquainted with the use of iron, that they were on that account stronger capacity or of higher culture than those tribes which had no iron, or even had no metal, and who were in the fullest sense in the stone age. The Central Africans generally found their iron ore on the surface, and extensive mining operations were not necessary. The lecturer described the smelting processes pursued by the negroes, and the implements used, the result of the operations noticed being, he said, a metal quite equal to the best forged iron of this country. He noted that the anvils and heavy hammers used in the iron production were stone, and not iron; but therein the negroes showed common sense; for it would be impossible for them to carry about with them heavy anvils and sledge-hammers of iron, while stone ones equally useful for the purpose in view could be had anywhere. The chisels and light hammers were, however, of iron, and the praise which had been bestowed on the work of the negro smith, on his swords, daggers, spear-heads, and arrow-heads, was exceedingly high. Their chains showed a refinement of form and a neatness of finish which vied with the best English steel chains. They worked in copper with which did its work well, as sand paper. On the whole, the wood-work showed a richer taste in form than the pottery, but it was in the same style.



THE NORCROSS DAMPER REGULATOR.

AN EVIDENCE OF INTELLECT IN BRUTES is stated in a communication of Mr. Arthur Nicols to *Nature*, from which we extract the following:

"The case will perhaps interest those who believe that the reasoning faculty in man and animals differs in degree only, and is essentially the same in kind. Some years ago a plumber told me that he had, on several occasions, been called in to examine into the cause of leakage of water-pipes under the flooring of houses, and had found that the rats had gnawed a hole in the leaden pipe to obtain water, and that great numbers of them had made it a common drinking-place, as evidenced by the quantity of dung lying about. The plumber brought me a piece of leaden pipe, about $\frac{1}{2}$ inch in diameter and $\frac{1}{4}$ inch in thickness, penetrated in two places, taken by himself from a house on Haverstock Hill. There are the marks of the incisors on the lead, as clear as an engraving; and a few hairs and two or three of the rats' vibrissæ have been pinched into the metal in the act of gnawing it. This crucial proof of brute intelligence—a rat will not drink foul water—interested me so much, that I ventured to send an account of it to Dr. Chas. Darwin, asking his opinion on the means by which the rats ascertained the presence of water in the pipe. To this he replied: "I cannot doubt about animals reasoning in a practical fashion. The case of rats is very curious. Do not they hear the water trickling?" It may be conceded that this explanation is the most probable, and if it be the true one we have an example of an animal using his senses to obtain the data for a process of reasoning, leading to conclusions about which he is so certain that he will go to the trouble of cutting through a considerable thickness of

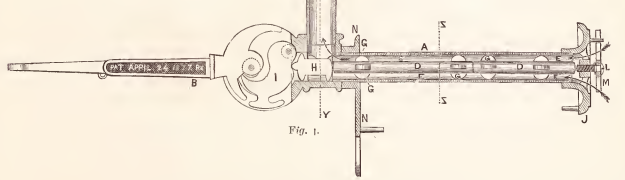


Fig. 1.

NORCROSS DAMPER REGULATOR DIAGRAM. FIG. 1.

The Norcross Damper Regulator.

HAVING been led to an examination of this device through a comparison of coal consumption in a furnace employed for heating his resi-

dence with the consumption in another furnace to which this invention has been applied during the past winter, a conviction of the value of the improvement, both as regards economy of fuel and attention, and the securing of more uniform temperature in buildings heated by the circulation of heated air, impels the writer to place before the readers of the SCIENTIFIC NEWS a detailed description of the improvement. The results of the observations above mentioned are such as justify us in commending the improvement to all who employ hot air furnaces. The apparatus is manufactured, applied, and guaranteed by the Norcross Automatic Furnace Regulator Company, 211 Fulton Street, Brooklyn, N. Y. The general agent for New York city and vicinity is Mr. W. E. Puffer, No. 7 Murray Street.

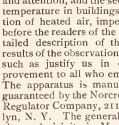


FIG. 2.

The large engraving illustrates the method of applying the regulator to an ordinary portable furnace. The details of the invention and their functions will be understood by reference to the diagrams Figs. 1, 2, 3, and 4, and the accompanying description.

In Fig. 1, *A* is a brass tube which expands and contracts with the variations of heat. *J* is a dial having openings *E E* to the tube. Fig. 2 shows the front of the dial. Fig. 3 is a cross section of the tube *A*, the iron rod *D*, and openings or air passages *E*, the section being made at *Z Z*, Fig. 1. *D* is a sectional iron rod held centrally in the tube by the radial flanges *G*; this rod is kept from expanding by a current of air passing through the tube around the rod and out at the upright draft tube *Y* (a vertical section of which at right angles with the section in Fig. 1 is shown in Fig. 4), performing the double purpose of keeping the rod cool and cooling the tube quickly as the heat of the furnace falls. *L* is a screw provided with an indicator *M* for adjusting the regulator to the required temperature. As the heat increases, the tube *A* will expand, and the end having the push pin *H*, will be carried forward against the compound lever *I* and *B*, causing the extreme end of *B* to fall, which is connected to the damper so as to *close* it, but if the heat decreases, the tube will contract, and the lever *I* will be pressed against the rod and screw, and lever *B* rises and *opens* the damper. Now if we turn the indicator to the right, the screw will force the rod forward and set the lever *B* higher, or, in other words, the regulator is adjusted for *more* heat; if *less* heat is desired, the indicator is simply set back one or more numbers as the case may require. To compensate for extreme variations in the heat of a furnace, the end of lever *B* may be moved about eight inches. When thus adjusted an expansion of one inch fully opens or closes the damper, and as it requires but a slight motion of the damper (when moved automatically) to keep the fire under perfect control, the regulator is extremely sensitive.

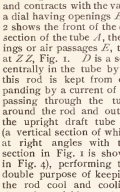


FIG. 4.

The original patent granted for this invention, dated April 24th, 1877, has been strengthened by Reissue No. 8582, February 18th, 1879.

Penguins at Home.

THE two islands St. Paul and Amsterdam, with their outlying rocks, lie about midway between Africa and Australia. These islands and rocks are of volcanic origin. Round about them the dredge brings up pieces of lava and ashes, and other evidences of their past history. At no great distance the sea is two thousand fathoms deep. In 1696 the crater of St. Paul was intact; but the sea now flows into it where its wall has been broken down, and a boat can row into the once fiery gulf of the volcano. The seas swarm with the lower forms of marine life, and gigantic octopeods, capable of drowning the strongest man.

Nature ever seeks to cover the waste places of the earth with vegetation. A chance cocoanut may be stranded on an old coral reef, and in a few years it is clothed with a fringe of these stately palms. In 1874 the botanists who were attached to the Transit of Venus expedition found more than fifty species of plants, excluding those of the lowest order, flourishing there. Plants prepare the soil for more noble occupants; and as the shores become sloped by the unceasing action of the sea, favorable opportunities occur for the lodgment of still higher forms of vegetable life. The origin of vegetation on islands situated as these are is due mainly to the agency of the sea in transporting to them the germs of plants.

About the month of September, the beginning of the summer in these latitudes, albatrosses resort to these solitary islands for the purpose of nesting; but the innumerable penguins which, from their incapacity for flight, are the permanent residents, are among the most interesting, because they form a commonwealth, and exhibit considerable dependence upon one another in the rearing of their young. The business begins with the laying of one or two eggs, never more, of a dirty white streaked with brown, in a hollow on the bare ground or on a little grass. The task of incubation is shared by both parents; the one "off duty" going to the sea to feed itself, and when the young are hatched, returning in due time with a supply for the family. Where tens of thousands of nests are collected together so closely that the visitor cannot walk without demolishing new-born nestlings or eggs at almost every step, it is difficult to understand how each bird knows its own nest, eggs, or nestling, as appears to be the case until the young are able to walk about for themselves. Then the latter form into "infant schools," presided over by several matrons, and ask and receive food from any charitable passer-by, and the social system, so far as it goes, has attained its highest point. Woe betide the incautious or overconfident experimenter who shall remove one of these fierce motherly things from her nest with his hands: the penalty will be a succession of stabs, which produce notoriously painful wounds. But the occupant of the nearest nest will always receive and tuck under her, together with her own brood, the young of a dispossessed neighbor. All through the nursery are well-beaten paths, along which the birds hop in single file with most grotesque action to and from the sea; and from the nests on either side come sharp stabs at the legs of the intruder, a deafening roar accompanying his progress the while, and an odor which only those who have sailed in a guano ship can realize.

The young must now be taught their first swimming-lessons, and the rudiments of that aquatic life to which their physical structure confines them. From the rookery to the sea they advance, hopping with both legs together, and jump feet foremost bolt upright from a ledge into the water. Then, and only then, are they thoroughly at home, and, making use of nothing but the powerful scaly flippers, dart about with the rapidity of a fish. Frequently the old bird will rise to the surface with a young one balanced on each flipper, maintained in its precarious position by the grasp of its own tiny paddles, and no doubt vastly enjoying this introduction to life and the novel experiences to be met with under water.

Penguins do not find life one long holiday; for at no great distance from the sporting multitude we can see ever and anon rising above the surface the unmistakable triangular backfin of a shark, stealthily approaching the revellers. They have observed the enemy as soon as we, and in a moment not a bird is to be seen. They have dived with one impulse to the bottom, where the tyrant cannot easily seize them, and are hurrying for their lives to the shore. The effect of the simultaneous reappearance of thousands of the ungainly creatures scuffling up the beach with a deafening clamor is most singular; and we peer down into the water for signs of the tragedy, if any has been enacted; but the shark is nowhere to be seen, and, confidence being re-established, the birds are soon at their gambols again.

The structure of these birds is admirably adapted to their mode of life. The fore limbs —which in most other birds are wings—are flattened out into a pair of broad swimming paddles covered with scales, enabling the bird to follow its prey beneath the water with a swiftness, grace, and ease contrasting remarkably with its awkward movements on land. The feet are broad and partially webbed, and the leg is modified in order to give stability to the body. Provision is made for long-continued diving by enlargement of the veins, which thus retain and act as reservoirs for the vitiated blood until it can be renovated by breathing. The bones are filled with oily marrow, and the feathers are exceedingly compact and well adapted to resist water. When moulting, the penguin avoids water, and the feathers come away in patches instead of singly; the whole process resembling more nearly the shedding of a snake's skin than the moulting of a bird.

McVeen's Patent Horse-Shoe.*

THIS invention, patented by Mr. McVeen, of Cleveland, Ohio, is destined, as he claims, to work a great reformation in the matter of horse-shoeing. The device consists of a metal or rubber band that passes around the hoof of the horse at the point where the nails in the ordinary shoe are clinched, and is attached to the shoe by means of three steel straps that form a part of the shoe, one from the front and one from each heel. In our illustration which we give with this article it will be observed that the band is loosened, in order to explain the manner of putting it on and taking it off, which requires but little time and no skilled labor. The shoes can be removed at any time in a few moments without destroying the hoof or going to a horse-shoer to have it done. In one of our engravings the calks, it will be observed, are, as in the ordinary shoe, at the extreme heel, whilst in the other it is near the centre of the foot. The former is for the hind foot, while the latter is the proper way to make a shoe for the front foot. It is well known by horsemen and farriers that much of the cause of lameness is by quarter cracks and cracked hoofs, and one of the great reasons for this is found in the fact that the weight of the horse

strikes first and chiefly on the heel, and prevents the natural and easy oscillation of the foot that is given by having the weight rest upon the centre. These shoes are made of steel, and are said to cost less than the ordinary shoes. Messrs. Protzman, Hillerman & Co., No. 12½ Superior street, Cleveland, Ohio, are, we believe, putting these shoes on the market.

Dodge's Stone and Ore Crusher.

THE accompanying diagram illustrates a stone and ore crusher now used to some extent in the Colorado mills for taking quick assay samples, for which work it is well adapted, as it has both sieves and rolls attached. To the performance of general work the well-known

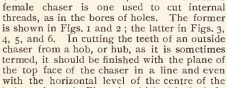
Blake's crusher is better adapted, but in the operation of sampling for assay the machine illustrated seems particularly fitted. It consists of two jaws *a*, which are bolted to their respec-

Am. Manufacturer.

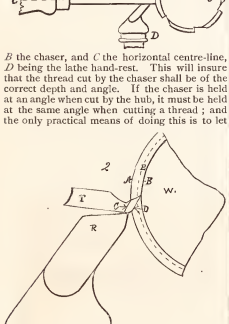
tive positions, one being fixed and the other movable, on a lever *c*, moved by an eccentric *b*. The box *d*, in which the fulcrum *e* of the lever *c* moves, is adjustable horizontally by set screws *f* and washers or plates *v*. The crusher proper is fastened to a stand to which the rollers *m* and *p* and the sieves *t* are attached. It is fastened by bolts *g*. A fly-wheel is attached to the shaft *i*, upon which the eccentric *h*, the pinion *k*, the ratchet-wheels *x*, and the fly-wheels *o*, with the tight and loose pulleys on the opposite side, are attached. The spur-wheel *l* is driven by the pinion *k*, which is keyed to the saft *n* of the roller *p*, which causes it to revolve. The other roller *m* is moved by a gear on the opposite side of the crusher. Its shaft is in a box adjustable by a set screw *q*, by a rubber spring *r*, backed with a cast-iron washer or cap between this box and the screw *q*, so as to give elasticity to the roller. There are four sets of gear, for the purpose of using the rolls until they are completely worn down. The sieve *t* is moved by a ratchet-lever *s*. The shaking-table *t*, containing the sieve, is for the purpoeed taking out that part of the ore already crushed between the jaws, and to relieve the rollers from the work of passing through them again ; also to distribute the ore evenly to the rollers from end to end, so that they should wear evenly. This shaking-table is supported by a lever *u* under the jaws of the stamp. The motion of the screen is assisted by a spring *w*. The crusher is provided with patent soft wrought-iron crushing jaws *a*, which it is asserted wear longer than hard cast-iron ones.

Chasers.

The chaser is a tool employed to cut screw threads. It is mostly used as a hand tool, but is sometimes held in the slide-rest and fed by the lathe-feed motion. This is necessary more especially with threads having a round top and bottom. An outside chaser is one used upon external or male threads, while an inside or female chaser is one used to cut internal threads, as in the bores of holes. The former is shown in Figs. 1 and 2 ; the latter in Figs. 3, 4, 5, and 6. In cutting the teeth of an outside chaser from a hob, or hub, as it is sometimes termed, it should be finished with the plane of the top face of the chaser in a line and even with the horizontal level of the centre of the hub, as shown in Fig. 1, in which *A* is the hub,

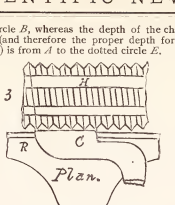


B the chaser, and *C* the horizontal centre-line, *D* being the lathe hand-rest. This will insure that the thread cut by the chaser shall be of the correct depth and angle. If the chaser is held at an angle when cut by the hub, it must be held at the same angle when cutting a thread ; and the only practical means of doing this is to let

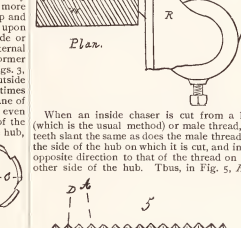


the teeth of the chaser lie against the work for their full length and then elevate the handle end of the chaser just sufficient to give the teeth points clearance enough to enable them to cut.

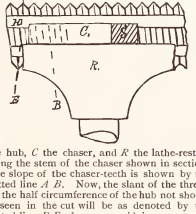
This is especially necessary with a chaser that has top-rake, as shown in Fig. 2 ; for if the chaser is elevated, as there shown, it will cut a thread deeper than are its own teeth, as illustrated—*W* representing the work, *R* the lathe-rest, and *T* the chaser. The depth of the thread in this case will be from the circle *A* to the circle *B*, whereas the depth of the chaser teeth (and therefore the proper depth for the thread) is from *A* to the dotted circle *E*.



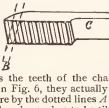
In order to enable the cutting of an inside chaser from a hub, it requires to be bent as in Fig. 3, in which *H* is the hub, *R* the lathe-rest, and *C* the chaser. After the chaser is cut, it has to be straightened out, as shown in Fig. 4, in which *W* represents a washer being threaded and shown in section, *C* the chaser, and *R* the lathe-rest, while *P* is a pin sometimes let into the lathe-rest to act as a fulcrum for the back of the chaser to force it to its cut, the handle end of the chaser being pressed inwards, as denoted by the arrow.



When an inside chaser is cut from a hub (which is the usual method) or male thread, its teeth slant the same as does the male thread on the side of the hub on which it is cut, and in an opposite direction to that of the thread on the other side of the hub. Thus, in Fig. 5, *H* is

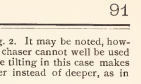


the hub, *C* the chaser, and *R* the lathe-rest, *S* being the stem of the chaser shown in section. The slope of the chaser-teeth is shown by the dotted line *A B*. Now, the slant of the thread on the half circumference of the hub not shown or seen in the cut will be as denoted by the dotted line *D E* ; hence, as said, in an opposite direction. Now, in turning the chaser over from the position in which it is cut (Fig. 5) to the position in which it is used (Fig. 6), and applying it from a male to a female thread, we reverse the direction with relation to the work in which the chaser-teeth slant ; or, in other words, whereas the teeth of the chaser should lie as shown in Fig. 6, they actually lie as denoted in that figure by the dotted lines *A B*. As a consequence, the chaser has to be tilted over enough to cause the sides of the chaser-teeth to clear the sides of the thread being cut, which, as they lie at opposite angles, is sufficient to cause the female thread cut by the chaser to be perceptibly shallower than the chaser-teeth, for reasons which have been explained



with reference to Fig. 2. It may be noted, however, that an inside chaser cannot well be used with rake, hence the tilting in this case makes the thread shallower instead of deeper, as in Fig. 2.

To obviate these difficulties the hub for cutting a right-hand inside chaser should have a left-hand thread upon it, and, *per contra*, an inside chaser for cutting a left-hand thread should be cut from a hub having a right-hand thread. In Fig. 7, *L* is a left-hand and *R* a right-hand thread, which will make the chaser-teeth lie at the same angle as does the thread to be cut, and the chaser should be tilted over only just sufficient to enable it to cut.



The Mutual Relations of Capital and Labor.

A PAPER READ AT THE CHURCH CONGRESS IN CINCINNATI, OCTOBER 18, 1878, BY HON. ABRAM S. HEWITT.

No. I.

The three cardinal and unchangeable facts of humanity are the Individual, the Family, and Society. There is and can be no other basis for government or religion. The fundamental characteristic of the individual is personal liberty ; of the family, love ; and of society, justice. Personal liberty implies equality of rights, and contains the germ of individual property, while justice implies its equitable distribution ; and this distribution can only rest upon the axiom, *to each according to his work*. The problem, therefore, presented to systems of religion and schemes of government, is, to make men who are equal in liberty—that is, in political rights, and therefore entitled to the ownership of property—content with that inequality in its distribution which must inevitably result from the application of the law of justice.

In the solution of this problem, all the ancient religions and governments absolutely failed. Briefly summed up, their progress was either from equality of property under the patriarchal system, or from equality of political rights under the early and rude democracies, into despotism in which no rights were respected, involving the almost total destruction of civilization, and ending in the long night of the middle ages. With the Christian religion, and the governments which have been based upon it as a foundation, the results have been directly the reverse. Christianity co-ordinates the individual, the family, and society into one harmonious scheme. It addresses itself to the personal conscience only, and its whole scope and efficacy is towards the development of the individual in all directions—physical, intellectual, and moral and spiritual. But the necessity for association in order to achieve results is not merely enjoined, but is the cardinal principle upon which the Church itself is constituted. Individualism and association thus go hand in hand in the march of progress ; and it is a most suggestive fact that in ancient times no considerable development of industry was ever achieved, and the reason is that either the energies of the individual were deprived of free play, or society was so organized that men could not work together in peace and harmony.

Looking back over the eighteen centuries since the Christian doctrine was first preached, it is not difficult to discover the methods by which its results have been accomplished ; but to one of the apostles looking forward into the centuries which have now passed it was impossible to comprehend or to predict by what means Christianity would work out its beneficent purpose. So, throughout the whole course of its history, its most devoted adherents, its ablest expounders, have not only mostly failed to discover its drift, but have frequently resisted its march of progress, as we now see, towards the successive steps by which it is developing itself into the fulness of its beneficence.

Let two illustrations suffice to prove this proposition. If individual liberty is to be maintained, then government must rest upon the consent of the governed. To this proposition is opposed the principle of the Divine right of kings to govern, and yet until within a century this theory was maintained by the ablest men in the Church. Nevertheless, the right of the people to govern themselves asserted itself by silent and irresistible progress, based upon the

growing convictions of mankind, until at last the whole theory of a Divine right to govern was overthrown in a cataclysm of blood at the close of the last century.

And so with personal slavery. When Christ began to preach a large portion of the human race was in bondage. He incited no insurrections. On the contrary, he counselled obedience to the law. Nevertheless, he preached a doctrine which, of its own innate power, has sufficed, by slow and silent growth, to undermine the foundations upon which the right of property in man was founded, and in our own day and generation the last stronghold surrendered; and henceforth the equality of men as to political rights will not be seriously controverted. And yet, during the eighteen hundred years which have been required for the accomplishment of this result of Christian doctrine, many of the ablest and best men in the Church resisted the operation of that silent law, which has at length secured to man the liberty with which Christ intended to make him free.

These primary steps in the Christian scheme —namely, the establishment of the right of men to govern themselves, and to own and control the fruits of their own labor—may thus be said to have been only completed in our own day.

Growth of wealth.

With the recognition of these rights has come a vast increase in the amount of wealth, which it is the object of society to accumulate and distribute. This growth in wealth is, so far as we can judge, the direct result of the physical, political, and mental enfranchisement of man. His energies, now for the first time unshackled, have penetrated into the boundless storehouse of Nature, captured the invisible forces which have heretofore guarded her treasures, and subjugated them to the service of the human race. But whether it be due to this cause or not, it is a fact that the growth in wealth has been contemporaneous with the enlargement of personal freedom.

The question of the distribution and ownership of property has always been one of primary concern to the human race, but when property is suddenly and enormously increased in amount, the question assumes a proportionably increased importance, and is surrounded with increased difficulties. Even if it be admitted that the existing system of distribution at any given time is equitable, it does not follow that upon a sudden development of wealth from new sources and by new agencies the old methods of distribution would continue to be just.

Hence controversies are inevitable. In ancient times these controversies resulted in intestine war and the destruction of government and society. In Christian times these controversies have not resulted in social disintegration, but, on the contrary, the social forces have been steadily developed and strengthened. The explanation of this difference is to be found in the fact that Christ based the organization of society upon the principle of justice, and whatever differences may have existed as to what justice requires, the conscience of society has come more and more to recognize the fact that it is to be done at whatever cost to vested interests, and the progress of society shows conclusively that there is a steady advance in the direction of justice.

(To be continued.)

Progress in Sciences and Arts.

The First Steel Bridge in America.—We learn that arrangements have been concluded by General D. D. Smith, the widely celebrated Chief Engineer of the Chicago and Alton railway, for constructing the first all steel bridge in America. General Smith will be remembered by his connection with the United States Government Board for testing the strength of iron and steel, experiments for which were carried on by him several years ago. General Smith's researches have at last brought him to the conclusion that steel bridges can be built cheaper than iron, and be equal in durability. The bridge will be erected over the Missouri River, on the Chicago and Alton railway. It will be of five spans of 350 feet each. The elevation over high water mark will not be less than 80 feet, at which height the light steel rods of the "Howe truss" will look like silver cobwebs, shimmering and glimmering in the sunshine. For all its frail appearance the bridge will have bearing strength reached by but few existing structures in the world. The total amount of steel used in the construction will be about 1500 tons, equivalent to almost double that quantity of iron.

An Alloy to Imitate Gold is said to have been produced by Messrs. Meiffren and Co., of Marseilles. They place in a crucible, copper as pure as possible, platinum, and tungstic acid in proportions as follows: For producing an alloy of red gold color—copper, 800 grammes; platinum, 25; tungstic acid, 10; and gold, 170 grammes. When the metals are completely melted they stir and granulate them by running them into water containing 500 grammes of slaked lime and 500 grammes of carbonate of potash for every cubic metre of water. This mixture, dissolved in water, has the property of rendering the alloy still purer. The granulated metal is next collected, dried, and after remelting in a crucible, a certain quantity of fine gold is added. An alloy is thus produced which, when run into ingots, presents the appearance of red gold of the standard $\frac{750}{1000}$. The color of the alloy may be changed varying the proportions of the different metals. As a flux boric acid, nitrate of soda, and chloride of sodium, previously melted together in equal proportions are used. The proportion of flux to be employed is 25 grammes per kilogramme of the alloy.

For the convenience of readers not familiar with French weights we add that a gramme is equal to $15\frac{432}{1000}$ grains Troy weight, a kilogramme $2\frac{679}{1000}$ lbs. Avoirdupois. The alloy stands a high acid test, and its specific gravity is also very close to that of gold of fineness indicated by the said test. We are informed also that other platinum alloys of gold which stand a high acid and gravity test have lately found their way into the American market in articles of jewelry.

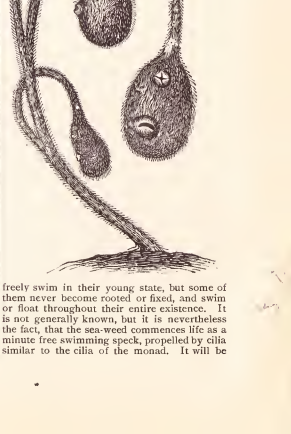
The Plant-Producing Caterpillar of New Zealand.—Among the many curious forms of animal and vegetable life at the Antipodes, perhaps none is more remarkable in number in certain parts of New Zealand, and less frequently in a somewhat different shape, in New South Wales. In the body of this caterpillar literally grows the root of a species of rush, or reed, whose stem, growing upwards in the ordinary manner above ground, is the perfect stem of a leafless vegetable, with a head somewhat resembling the head of a bulrush. The heads, or seed vessels of the plant, are eaten by the Maories, and, when burnt, are employed as a coloring matter; the plant, when roasted, emits a strong animal smell. The natural history of this curious organism is briefly as follows: The caterpillar known as the "Aweto," or *Hipialus virescens*, when burrowing underground previous to its metamorphosis to the chrysalis state, collects one or more of the seeds of a parasitic fungus (*Sphæria Robertsii*) in the joints of its neck, where, nurtured by the warmth of the body, they quickly germinate, the roots pressing downwards and completely filling the skin of the caterpillar's body, and the stem springing upwards through the light rich soil till it attains a height of some eight or ten inches. The caterpillars seldom or never exceed three to four inches in length, and the root of the plant appears invariably to confine itself to the shell of the insect, which preserves its outward form intact, the feet, eyes, and scales appearing perfect. Wherever the club-shaped heads of the plant are seen, its caterpillar root may easily be found by digging carefully downwards to a distance of several inches. This remarkable instance of a caterpillar, naturally destined to develop into a gaudy butterfly, transforming itself into an integral radical portion of an insignificant plant, seems like a protest against the ravages which these larvæ usually commit on the produce of the vegetable kingdom.

Borax as a Preservative of Meat is strongly condemned by M. Le Bon, a French savant, who points out that while this substance is an excellent preservative agent, it nevertheless originates serious intestinal derangements, when meat thus preserved is taken as food. Its poisonous action on plants, he notes, has already been pointed out by M. Peligot. He expresses also a general disapproval of the use of saline substances as food preservers, an object for which he considers cold to be the only unobjectionable agent.

A New Steering Apparatus for steam vessels has been invented by Samuel G. Martin, Captain of the well-known steamer Plymouth Rock. It has been tried and is very highly spoken of by many owners and commanders of vessels who have witnessed its performance. The trial took place in very rough weather, and is deemed conclusive of the value of the invention. An upright lever in the wheel-house slides from side to side on a simple curved iron frame just above the floor. It is attached to a long rod underneath the floor, and the rod in turn works a "three-way" valve. As the lever is moved by the pilot, it turns this valve, admitting steam to the cylinders through two of the three "ways" in the valve. The rudder-chains are attached to the pistons running through these cylinders. When the lever is straight steam is admitted equally to each, and there is an equal pressure on the pistons. As the lever is moved and the rudder turns, steam is transferred from one cylinder to the other, the piston of the former going out, of course, and that of the other proportionately running in. Any slack in the rudder-chains at the stern is thus immediately taken up, and at all times the chains are taut. When the lever is turned below a certain point the third "way" of the "three-way" valve comes into play as an exhaust pipe, the cylinders are exhausted, and the steam shut off. A simple movement of the lever in the wheel-house, which any boy can handle, regulates the whole apparatus. This simplicity is one of the new invention's special features. Another feature is its saving of labor. One man only is required to attend to it in any case. Under the present system of wheel steering, two, three, four, and often more men have to tug and pull to steer some of the larger sea or river steamships, even in smooth water. Steam steering gears now in use on ocean steamers require a separate engine, with its engineers and fuel, extra helmsmen, and an initial outlay of $2000 to $3000. Captain Martin's invention taps the vessel's boiler for its motive power, can be used as long as there is steam enough to run the vessel itself, and costs less than half as much as the old steam system. By keeping the rudder-chains always taut, the rudder can be turned very much quicker than now, saving both time and distance.

The Sea-Squirt. (*Ascidia pedunculata.*)

This is an example of one of those singular beings which have so much puzzled naturalists in assigning a boundary between the vegetable and animal kingdoms. It is, in fact, a rooted animal. It resembles a plant in having clearly defined roots, a stalk and branches or peduncules, to the extremities of which are attached stomachs which receive and digest food and eject excrementitious matter. In its first stages the sea-squirt swims freely about in the same manner as sponges, corals, and sea-anemones; but then it is also true of many plants that they



freely swim in their young state, but some of them never become rooted or fixed, and swim or float throughout their entire existence. It is not generally known, but it is nevertheless the fact, that the sea-weed commences life as a minute free swimming speck, propelled by cilia similar to the cilia of the monad. It will be

seen from these few examples that the difficulties of determining the lower animals from plants on mechanical principles are so great as to be insurmountable. Equally great difficulties are met in the application of chemical or microscopical tests. Physiology finds itself on the same footing in the attempt to separate plants from animals by consideration of manifestations of nervous, assimilative, or reproductive power. A line between the two kingdoms therefore does not probably exist, the one overlapping or merging into the other.

Shop and House Hints.

Lining Forged Work.—Forged work should always be lined off, which will save in many cases a forging that would be spoiled. Suppose, for instance, we have a piece of work such as shown in Fig. 1, there being just sufficient metal at I, F, and E to allow those faces to turn up. In the absence of the dotted marking lines G, H, I, J, K, L a trifle too much metal taken off F would make the faces I and E deficient; hence the only method of

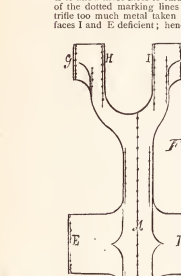


Fig. 1.

knowing just how much metal to take off the respective faces is to mark each off as shown, and then mark the line A, which will serve to set the work at each setting when operated upon either in the lathe, planer, or slotter. In marking off the holes B, C, D, the circles to set them by should

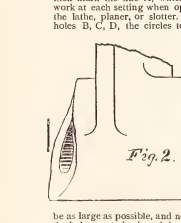


Fig. 2.

be as large as possible, and not of the sizes to which the holes are to be bored, because large circles are more easily set true. The method of testing these circles is shown in Fig. 2, P being a pointer fastened in the tool-rest.

To Scrub a Carpet Successfully.—A writer for the Household gives the following directions: Sweep it well first, then take a half-pail of water, hot as can be borne; put in a tablespoonful of ammonia. Have a stiff scrubbing-brush and borax soap, and scrub a small place; have a second pail of water and ammonia; rinse off with this, and, with a woollen cloth, wipe as dry as possible. Renew the water often, until the whole carpet is cleansed. Then open the doors and windows to dry it. This removes the grease stains and brightens the carpet.

Packing Glassware.—Every one has this duty to perform occasionally, and it is well to know how it should be done. The safety of glass articles packed together in a box does not depend so much upon the quantity of packing material used, as upon the fact that no two pieces of glass come into actual contact. In packing plates, a single straw placed between two of them will prevent them from breaking each other. In packing bottles in a case, such as the collecting case of the microscopist, and the test case of the chemist, rubber rings slipped over each will be found the best and handiest packing material. They have this great advantage, that they do not give rise to dust.

Horse Power of Boiler and Engine.—W. D. B. asks to be informed what is the horse-power of a boiler, giving some of the dimensions, yet not enough for an estimation on the basis of heating surface. He simply gives length and diameter of cylinder, and number and diameter of tubes, but omits any mention of dimensions of crown-sheet, length of tubes, etc. While an estimate may be made on the basis of heating surface, the only way that the horse-power of any boiler can be determined is by actual test of evaporative power. The old rule is that the boiler shall evaporate a cubic foot of water per hour for each horse-power; but this evaporative capacity will answer for very coarse practice so far as the engine is concerned. Modern refinements in the steam-engine have reduced the amount of water necessary to be evaporated to give a horse-power. From 15 to 18 square feet of heating surface, and one square foot of grate surface, are required by the same rule for the stated amount of evaporation.

This correspondent also asks the horse-power of a steam-engine having cylinder 8 inches internal diameter and 12 inches stroke, making 150 revolutions per minute, at 60 lbs. pressure. We assume the pressure named to be mean effective pressure, though this is not stated. If 60 lbs. be the boiler pressure by gauge, the mean effective pressure in the cylinder will be somewhat less; and if the steam be cut-off at any part of the stroke, it will be considerably less, depending not only upon the point of cut-off, but also upon the freedom of induction and eduction of steam to and from the cylinder, the amount of radiation of heat from the cylinder, etc. The only positive way of determining the mean effective pressure is by the employment of an indicator. Assuming, however, the mean effective pressure to be 60 lbs., the following will be the computation:

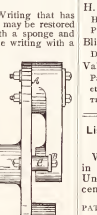
Diameter squared, $64 \times 0{\cdot}7854$ = area of piston in square inches = 50·2656. Then $50{\cdot}2656 \times 60$ = total mean effective pressure on piston = 3015·936 lbs. Then travel of the piston per minute = 300 ft. $\times$ 3015·936 lbs. = total work performed in one minute of time = 904780·8 foot-lbs. Then

$$\frac{904780{\cdot}8 \text{ foot-lbs.}}{33000 \text{ foot-lbs. in 1 H. P.}} = 27{\cdot}417 \text{ H. P.}$$

= No. of foot-lbs. in 1 H. P.

Cleaning Glass Bottles.—It is stated that glass bottles may be quickly and thoroughly cleansed from all traces of adhering fatty or oily matters by the use of a concentrated solution of permanganate of potash to which a few drops of hydrochloric acid are added. The solution is employed by washing and rinsing. The hydrochloric acid sets free a little caustic potash, which in some way appears to be more active in its effect upon the oily or greasy matters than when presented in the ordinary way. We wish it understood that we do not vouch for the value of this recipe. We reproduce it from the *Druggists' Circular* merely as a hint which may be cheaply tried.

To Restore Old Writing.—Writing that has become faded or illegible by time may be restored by going first over the surface with a sponge and warm water, then passing over the writing with a



pencil moistened with a weak solution of sulphide of ammonium. In most cases this will at once restore the color to the text. The success of the process depends on the fact that such old writings have been made with an iron ink, and the action of the sulphide causes the production of the sulphide of iron.

To Chuck a Crank True, the bore at the large end and the radial face at that end should be turned first. The second chucking should be as in the figure, the turned face A being bolted to the face-plate, the plate at B being bolted to the washer C, and through it to the face-plate. The duty of B is simply to steady that end of the crank, and not to clamp it.

Liquid Glue.—Dilute officinal phosphoric acid with two parts, by weight, of water, and saturate with carbonate of ammonia; dilute the resulting liquid, which is now still somewhat acid, with another part of distilled water, warm it on a water-bath, and dissolve in it enough good glue to form a thick, syrupy liquid. It must be kept in well-closed bottles.

To Restore Elasticity of Rubber Springs, Bands, Etc.—Place the rubber bands or springs in hot water. Prof. Tait asserts that india-rubber, after having been stretched for years and become permanently strained, or if it be stretched while warm nearly to rupture, will recover its former dimensions when it is dipped into hot water.

Roller Skates.—Almost any lad may make him a pair of roller skates with but little trouble. They will not be quite so handsome or useful as those which may be bought, but they will answer very well. A A are two wheels, mounted in forks, which

turn on pivots; ordinary castors may be used if about two inches in diameter. B B are two forks fastened to the castors, and are detailed in D. C is an elastic band, which connects B B. The rest of the diagram explains itself.

Business Hints.

Fifty Cents per Line, in advance, will be Charged for all Business and Personal Notices admitted into this Column. Cuts cannot be admitted.

List of Patents Granted March 11th and 18th, 1879.

We will supply copies of any of the patents in this list, post-paid, to any address in the United States or Canada, on receipt of 50 cents per copy.

PATENTS GRANTED ON THE 11TH DAY OF MARCH, 1879.

Abdominal appliances for movement cure, D. T. Gale 213,044
Advertising-card, J. H. Hunt 213,045
Alarm-lock, T. N. Roberts 213,049
Artist's kit, W. H. Brownell 213,166
Axle and box, vehicle, O. Reinle 213,073
Axle box, car, W. W. Worswick 213,082
Axle, vehicle, E. E. Lincoln 213,117
Bails, machine for making pail, L. Williams 213,081
Baker's cabinet, W. L. Allen 213,155
Ballot-box, J. Powell 213,133
Barrel-chock, G. S. Jewell 213,203
Batting, package of cotton, G. M. Hamlin 213,046
Beads, stringing, S. M. and J. C. Lewis 213,225
Bed-bottom, A. C. Langworthy 213,215
Beehive, J. J. Lawson 213,222
Beer, pressure regulator for fermenting, M. Tschurtz 213,148
Bell, gong, J. S. Crane 213,176
Bird-seed reservoir, O. W. Taft 213,145
Blue, manufacture of Prussian, L. Graf 213,189
Boat lowering and detaching device, W. A. Brice. 213,165
Boot and shoe, L. Loser 213,227

Boot and shoe heel stiffeners, machine for crimping, M. H. Hall ... 213,191
Boot upper, S. A. Robinson ... 213,250
Boots and shoes, manufacture of, W. R. Miller ... 213,231
Bow and arrow, W. H. Wright and G. L. Thorne ... 213,083
Box-catch, A. Gaertner ... 213,102
Bracket, O. A. Bingham ... 213,034
Bread-box, W. G. Jones ... 213,206
Brick, etc., kiln for burning, N. Lodge ... 213,216
Brick-machine, J. C. Anderson ... 213,085
Bridges, construction of, E. Williams ... 213,154
Bridle-bit for horses, G. D. Dudley ... 213,099
Buckle, harness, J. P. Hisley ... 213,200
Buckle, trace, H. Persels ... 213,063
Buffer-spring, W. M. Betts ... 213,032
Calculator, tax, R. L. Mudd ... 213,234
Candlestick, J. Frick ... 213,184
Car-brake, R. D. Chatterton ... 213,171
Car-brake, A. Weymouth ... 213,153
Car-coupling, L. L. Maxhimer and H. Trubey ... 213,122
Car-coupling, J. C. McCollum ... 213,055
Car, railway hand, G. S. Sheffield ... 213,254
Car-wheel, S. L. Wiegand ... 213,270
Carriage-boots, clasp or fastening for, A. G. Snell ... 213,256
Carriage-bow rest, J. E. Reeves ... 213,248
Casting mould-boards, W. J. Adams ... 213,027
Catafalque, E. H. Parker ... 213,130
Churn, S. O. R. Harris ... 213,195
Churn, A. Muller ... 213,127
Circuit-closer lock, C. H. Pond ... 213,064
Clothes-horse, H. S. Thompson ... 213,078
Coat and hat hook, E. E. Stow ... 213,260
Cock, gauge, T. R. Bingham ... 213,033
Collar-cap press, G. Chamberlin ... 213,170
Colter, wheel, J. Lane ... 213,049
Colter, wheel, T. Pates ... 213,061
Corn-shelling machine, S. M. Massie ... 213,120
Corset, C. H. Carlson ... 213,094
Cribbage-box, M. Greenspecht ... 213,045
Curtain-fixture, R. D. Whitaker ... 213,269
Dental drill, C. Poor (reissue) ... 8,624
Dental-engine hand-piece, B. S. Brown ... 213,167
Dental plugger, H. Richmann ... 213,134
Domestic boiler, S. W. Bradley ... 213,036
Door-bolt, T. Fairchild and C. Hazeltine ... 213,182
Door-spring, T. W. Hill ... 213,199
Draft attachment for vehicles, G. A. Hall ... 213,190
Dust-pan, W. W. and F. B. Mix ... 213,232
Electro-magnetic engine, C. T. Mason ... 213,220
Elliptic spring, H. C. Lüders ... 213,218
Elliptic springs, manufacture of ear-blanks for, W. Evans (reissue) ... 8,612
Fan, automatic, T. J. Bottoms ... 213,164
Fan, automatic, J. Watts ... 213,266
Feather-renovator, T. F. McBride ... 213,223
Fence-barbs from wire, machine for cutting, J. Neimeyer ... 213,237
Fence-posts, iron, S. Metzler ... 213,054
Fertilizer-distributers, feed-cup for, W. Marks and G. Jessup ... 213,053
File case or box, S. Duryee ... 213,040
Filtering semi-fluids under pressure, apparatus for, W. Neeham, J. and J. Kite, 2d ... 213,236
Fire-arm, revolving, P. Mauser ... 213,221
Fire-extinguishing apparatus, E. C. Lefferts ... 213,116
Flour and meal chest with sifting attachment, H. S. G. and H. B. Ray ... 213,069
Flour-commode, J. Johnson ... 213,205
Flour-mills, apparatus for collecting flour and other dust from, C. C. Washburn ... 213,151
Fruit-drier, R. Moore and P. D. Bruner ... 213,233
Fruit-gatherer, G. G. B. Greenwood ... 213,105
Furnaces, apparatus for supplying fuel to boiler and other, J. Proctor ... 213,067
Game apparatus, C. G. Knight ... 213,209
Game-indicator, A. H. Jones and I. Osgood ... 213,113
Gate, F. P. Gladfelter ... 213,187
Gate, J. E. Q. Maddox and G. P. Humphries ... 213,119
Grain and middlings separator, W. H. Rhodes ... 213,070
Grain-separator, J. Allonas ... 213,156
Grate, G. B. Mershon ... 213,228
Grater, nutmeg, W. Nash ... 213,059
Grinding-mill, J. W. and S. J. Woodcock ... 213,273
Grinding-mill burr, M. F. Connett ... 213,175
Harness, C. S. Piersons ... 213,246
Harvester, C. P. Gronberg ... 213,106
Harvester-pitman connection, W. B. Dunning ... 213,039
Hats of straw, palm-leaf, etc., C. M. Osgood ... 213,240
Heat and ventilation, producing, M. A. Shepard ... 213,138
Hitching-bar, A. L. Andrews ... 213,084
Hop-press, J. E. McCabe ... 213,123
Horse-bit, J. Stanley ... 213,258
Horse hampering-pad, W. E. Washburn ... 213,265
Hose-coupling, A. Work ... 213,274
Hydraulic elevator, S. Swartz ... 213,143
Hydro-motor, E. Fleischer ... 213,101
Ice-making machines, cell for tanks of, F. N. Mackay ... 213,219
Insect-trap, W. J. Quinn ... 213,068
Insects by fumigation, apparatus for destroying, L. C. Root ... 213,251
Insects, fumigating apparatus for exterminating, O. Mueller ... 213,235
Iron and steel by magnetism, ascertaining the density and tensile strength of, A. Herring ... 213,197
Knockdown chair, W. W. Hopkins ... 213,111
Lamp, D. Lubin ... 213,052
Lamp, W. H. H. Stineman and D. H. Flack ... 213,141
Leather-buffing roll, W. Place ... 213,247
Leather piping, Z. M. Lane ... 213,211
Lever, device for placing the working of more than one engine or mechanism under the control of a single, H. Wadsworth ... 213,079
Life-preserver, F. G. C. Weir ... 213,152
Lock, J. Sargent ... 213,252
Locomotive and dummy engine, E. D. McCracken ... 213,224
Loom-shedding mechanism, O. W. Kenison ... 213,208
Loom-shuttle, C. I. Kane ... 213,207
Loom-shuttle, metallic, W. Beatty and G. M Edwards ... 213,031
Loom-shuttle, motion, A. Faulkner ... 213,183
Lubricator, E. F. Gordon ... 213,104
Malt liquors, preventing galvanic action in the manufacture of, H. Strater, Jr., and H. H. Rueter ... 213,142
Mash from whole kernels, process and apparatus for preparing maize, C. A. O. and G. A. P. Bohm ... 223,092
Match-safe, E. H Whitney (reissue) ... 8,621
Measure and funnel, wooden liquid, C. V. Pettibone ... 213,244
Measuring tank, liquid, W. Baldwin ... 213,161
Metals, preparing paper, etc., for protecting, S. C. Eaton ... 213,100
Moulder's tool, G. Shedd ... 213,073
Musical instrument, mechanical, O. H. Arno ... 213,160
Nail-driving machine, R. M. Bidelman ... 213,162
Nozzle for hardening dies, J. B. Harmsted ... 213,194
Nursery-chair, W. E. Harrison ... 213,108
Organs, blow-pedal for, J. H. White ... 213,268
Overalls, H. F. Woodward (reissue) ... 8,617
Pan-forming machine, T. R. Morgan, Sr. ... 213,126
Paper-bag machine, triangular, E. Nugent and J. Burns ... 213,060
Paper-cutting machine, A. Beck ... 213,089
Paper, expansible and contractible core for rolls of, J. P. Vienot ... 213,262
Pea-shelling machine, J. Budd ... 213,168
Picture-frame attachment, H. A. Peaslee ... 213,131
Picture-support, V. Vizet ... 213,263
Pipe-coupling, A. S. Brownell ... 213,037
Planer, road, J. P. Lafetra ... 213,210
Planing and matching machine, W. H. Doane ... 213,180
Planter, convertible corn, A. Runstetler (reissue) ... 8,614
Planter, corn, J. M. Brownwell ... 213,093
Planter, corn, S. Page ... 213,241
Planter, seed, W. J. Mercer ... 213,227
Planter, seed, J. H. Morgan ... 213,057
Planter, seed, J. Preston, C. W. Tennis, and J. B. Hamilton ... 213,066
Plate-holder, V. Vizet ... 213,264
Plough, A. Goodyear ... 213,188
Plough, G. D. Loomis ... 213,051
Plough, G. W. McDaniel ... 213,225
Plough, A. W. Tucker ... 213,149
Plough attachment, wheel, J. R. Cummins ... 213,178
Plough, hill-side, W. E. Connelly ... 213,095
Plough, rotary gang, N. Palmer ... 213,242
Printing-machine, cylinder, H. B. Denny ... 213,098
Pulley for travelling cables, supporting, O. H. Jadwin (reissue) ... 8,619
Pulverizer, ground, E. D. Fink ... 213,185
Pump base, vacuum, G. Payne ... 213,243
Pumping fluids, gases, etc., compound valve for, L. O. Gassett ... 213,186
Railway-frog, E. H Johnston ... 213,204
Railway-rail, M. R. Perkins ... 213,132
Railways, apparatus for destroying vegetation on, L. B. Simpson ... 213,255
Raising heavy bodies, apparatus for, T. C. Naramore ... 213,128
Rocking-chair, W. H. Haman ... 213,192
Roofs, construction of, J. Boyd ... 213,035
Roving-machine fliers, G. J. Hazard ... 213,196
Rowlock, I. H. Wright ... 213,125
Rubber roller for clothes-wringers and other purposes, vulcanized, G. H. Hood ... 213.110
Ruling machine, paper, J. C. Forman ... 213,042
Saw, cotton-gin, J. E. Carver ... 213,169
Saw sharpener, gin, P. Armstrong ... 213,158
Sawing-machine, band, C. H. Mayo ... 213,222
Scales, weighing, F. D. Payn ... 213.062
Scoop and sifter, combined flour, J. R. Hughes ... 213,047
Seed-drill, S. W. Bard ... 213,088
Seed-dropper, J. M. Forden (reissue) ... 8,613
Seeds, method and apparatus for treating, W. B. Fisher (reissue) ... 8,615
Service-box and valve for closet-cisterns, E. W. Meyer ... 213,230
Sewing-machine, G. S. Darling ... 213,038
Sewing-machine, L. Dustin ... 213,181
Sewing-machine, J. N. Tarbox ... 213,146
Sheet-metal box, D. M. Somers ... 213,074
Sheet-metal pipes, grooving, C. Letterman ... 213,214
Shingle-cutting machine, W. Goldie ... 213,103
Shipping-case, H. S. Sprague ... 213,140
Shutter bower and fastener, T. B. Rogers, Jr. (reissue) ... 8,616
Sink-trap, J. T. Bladen ... 213,163
Slate-frame, H L. Andrews ... 213,028
Spark-arrester, J. L. Jacobs ... 213,112
Speculum-suppositor, D. T. Gale ... 213.043
Spokeshave, C. Spring ... 213.257
Stamping-mills, guide for the stems of, C. Crane and W. Raup ... 213,177
Steam-engine regulating device, C. C. Jenkins ... 213,202
Steam-engine, rotary, J. H. Darragh ... 213,096
Still, oil, C. Alvord ... 213,157
Stockings, fastening device or clasp for supporting, A. B. Shaw (reissue) ... 8,622
Stone, manufacture of artificial, H. Bacon ... 213,087
Stone, manufacture of artificial, T. P. Hall ... 213,107
Stool, camp, S. N. Stewart ... 213,259
Stove, steam cooking, J. Ashcroft ... 213,029
Stoves, laundry attachment for, B. Swift ... 213,144
Straw-cutter, T. B. Shaw ... 213,253
Stuffing-box for valves, etc., J. O'Meara ... 213,239
Sugar-liquoring apparatus, E. Langen (reissue) ... 8,620
Swing, O. Unzicker ... 213,150
Syringe, agricultural, P. C. Lewis ... 213,050
Tables, fly-fan attachment for, J. E. Hanger ... 213,193
Tapping attachment for barrels and other vessels, J. H. Armstrong ... 213,159
Tassel, muff, M. Silberstein ... 213,139
Telegraph, automatic fire-alarm, J. H. Guest (reissue ... 8.618
Telegraph instrument, fire-alarm, C. H. Pond ... 213.065
Telephone, electric speaking, A. G. Bell ... 213.090
Thill-coupling, J. McDermott ... 213,226
Thimble and thread-cutter, combined, A. McIntosh ... 213,124
Tinware vessel, W. G. Moore ... 213,056
Tobacco-dressing machine, C. R. Messinger ... 213.229
Towing canal-boats, H. Stevenson ... 213,076
Truss, F. Wilkins and A. A. McLean ... 213,271
Truss-pad, N. Jones (reissue) ... 8,623
Twine-holder, G. H. Stedman ... 213,075
Valve, balance puppet, L. D. Bartlett ... 213,030
Valve-gear, G. E. Tower ... 213,261
Valve, vacuum, N. C. Locke ... 213,118
Vapor-burner, Z. Davis ... 213,097
Vapor-burner, J. S. Kellogg ... 213,114
Vault, burial, S. G. Maus ... 213,121
Vegetable-cutter, T. Tschanun ... 213,147
Vehicle-spring, S. S. Claar ... 213,172
Vehicle-top prop, C. F. Odell ... 213,129
Velocipede, H. Hinckley and N. H. Culver ... 213,109
Ventilating and sewer connection for houses, W. Pickhardt ... 213,245
Vessels, construction of hulls of, T. Lee ... 213,213
Vise, B. W. Storey ... 213,077
Wagon-reaches, rub-iron for, A. B. Webster ... 213,267
Washing-machine, T. S. Anway ... 213,086
Watch, stop, U. A. Juvet ... 213,048
Watchman's detector, G. H. Roth ... 213,072
Watchman's detector, G. H. Roth ... 213,135
Watchman's detector, G. H. Roth ... 213,136
Water-elevator, A. W. Coates ... 213,173
Water gauge and alarm, O. Collier ... 213,174
Water to tanks, machinery for regulating the supply of, K. and D. L. Murchison ... 213,058
Water-wheel, turbine, J. T. Wilder ... 213.080
Whiffletree, T. S. Hill ... 213,198
Whiffletree-hook, G. W. Jackman ... 213,201
Whip-socket, O. B. North ... 213,238
Whip-socket, E. W. Scott ... 213,137
Whistle, steam, F. A. Wood ... 213,272
Window-screen, W. H. Betts ... 213,091
Wood, bending thin sheets of, T. B. De Forest ... 213,179
Wrench for inserting bung-brushes, D. Ackermann ... 213,026

PATENTS GRANTED ON THE 18TH DAY OF MARCH, 1879.

Addressing-machine, D. F. Bell ... 213,315
Ammoniacal gas, apparatus for obtaining dry, F. M. McMillan ... 213,294
Annunciator, electric, L. Finger ... 213 282
Automatic press-screw, E. M. Ivens ... 213,334
Axle lubricator, vehicle, J. M. Smith ... 213,461
Bag-holder, D. and C. Garver (reissue) ... 8,625
Baling-press, P. K. Dederick ... 213,280
Barrel and cask scrubbing machine, C. Pohl ... 213,447
Barrel-cover, L. Black and R. D. McManigal ... 213,316
Bellows-valve, J. Badger and H. P. Benjamin ... 213,375
Bird-cage support, F. W. Long ... 213,433
Bit-stock, L. C. Di Bert ... 213,399
Boiler, S. J. Gold ... 213,411
Boiler-furnace and feed-water heater, P. Sullivan ... 213,468
Book-cover, removable, W. H. Douty and C. H. Drake ... 213,401
Book-cover, removable, C. H. Drake ... 213,402
Book-cover, removable, C. H. Drake ... 213.403
Book-cover, removable, C. H. Drake ... 213,404
Boot and shoe heels and soles, manufacture of, J. M. Watson ... 213,364
Boot and shoe lasting machinery, C. H. Trask and H. F. Wheeler (reissue) ... 8,627
Boot-strap, J. B. Belcher ... 213,380
Bottle-stopper, J. E. Woodward ... 213,488
Bow, archery, F. Malleson ... 213,434
Brick-mould, J. E. Allen and P. F. Duffy ... 213,371
Butter-package, A. G. Stilson ... 213,357
Button-fastening, G. W. Hatch (reissue) ... 8,629
Cakes with sugar, etc., apparatus for coating, J. W. and A. Ruger ... 213,453
Can-case, J. M. Bean ... 213,275
Car-brake, L. Becker ... 213,378
Car-brake, B. F. Stewart ... 213,305
Car-coupling, L. A. Spear ... 213,464
Car, sleeping, C. C. Converse ... 213,279
Car-ventilator, B. F. Card ... 213,322
Cars, mechanism for driving fan-blowers in railway, J. H. Wickes ... 213,481
Cars, safety-guard for street, W. N. Morrison ... 213,295
Carbureter, F. J. Roth ... 213,351
Card or ticket holder, S. Stieglitz ... 213,306
Carpet-sweeper, A. H. Knapp ... 213,336
Carriage-step, R. N. B. Kirkham ... 213,429
Carriage-top, F. Smiley ... 213,355
Casting stereotype-plates, B. B. Huntoon ... 213,427
Cement, manufacture of Portland, C. H. Slicer ... 213,459
Chimney-cleaner, T. Toyson ... 213,472
Churn, A. Johnson ... 213,287
Churn, A. K. Morse ... 213,441
Churn, E. B. Older and F. E. R. Megow ... 213,444
Churn, S. R. Ruckel ... 213,452
Cigarette, Medical, F. J. Kochert ... 213,431
Clock-dial, S. E. Root ... 213,350
Clothes-stick, S. E. Bauder ... 213,377
Cocks, box and protector for underground stop, F. Hickman ... 213,419
Coin-package, C. H. Upton ... 213,361
Collar, horse, M. Turley ... 213,474
Copper from its solution, apparatus for obtaining metallic, C. C. Bitner ... 213,382
Corset, J. C. Tallman ... 213,358
Corset, J. C. Tallman ... 213,469
Cotton-chopper, W. T. Young and W. D. Moody ... 213,489
Cotton-press, T. B. Taylor ... 213.470
Cultivator, C. McGrew ... 213,341
Curtain-fixture, J. S. Henry ... 213,417
Cut-off for steam-engines, automatic, G. H. Cobb ... 213,392
Dental saliva-ejector, G. B. Snow ... 213,356
Dovetailing machine, miter, F. A. Gleason ... 213,329
Draft-equalizer, J. C. Bloom ... 213,383
Drawer-pull, T. S. Alexander ... 213,369
Drawer-pull, T. S. Alexander ... 213,370
Drawers, G. D. Eighmie ... 213,405
Evaporating-pan, J. L. Becker ... 213,379
Feed-water apparatus, attachment for, B. Clegg ... 213,390
Fertilizer distributer and seed-planter, T. S. Smith ... 213,303
Fifth-wheel, C. B. Lewis ... 213,291
Fire-escape apparatus, J. C. Foley ... 213,327
Fire-place heater, J. B. Oldershaw ... 213,445
Garden-roller, J. W. Hobson ... 213,420
Garments, device for shaping and pressing, J. Braun ... 213,384
Gas-generating furnace, E. Brook and A. Wilson ... 213,318
Gas-regulating burner, J. J. Kennevan ... 213,335
Gearing, variable speed, S. D. Locke ... 213,338
Glass-furnace, J. Kress ... 213,289
Governor for steam-engines, auxiliary, J. Milton ... 213,440
Grain *in vacuo*, process and apparatus for reducing, J. B. Toufflin ... 213,471
Grain, etc., machine for separating, C. G. and W. Stoll (reissue) ... 8,628
Grain-separator, G. W. Baker ... 213,313
Grain-spout, adjustable, F. M. Campbell ... 213,278
Gun-stock, J. C. Thompson ... 213,307
Harrow-tooth, D. D. Johnston ... 213,428
Hay-rack and fence, combined, L. Prince ... 213,448
Hide-stretching machine, W. Coupe ... 213,323
Hoisting-drum and clutch apparatus, H. Whiteley ... 213,366
Hose-armor, H. Wakeman ... 213,363
Hub-attaching device, R. Howland ... 213,425
Inlaying metallic ornaments in wood or stone, L. A. Amouroux ... 213,372
Kiln for carbonizing street-refuse, A. Fryer ... 213,409
Knitting-machine, J. A. Parr ... 213,299
Lamp-fixture, extension, F. R. Seidensticker ... 213,457
Lamp, hanging, P. J. Clark and J. Kintz ... 213,389
Lantern, P. J. Clark ... 213,388
Lap-joint for boilers and other vessels, L. S. White ... 213,480
Letter clip and file, L. Aubel ... 213,374
Leveller, road, F. B. Kendell ... 213,288
Lightning-rod, L. Adams ... 213,367
Lime, manufacture of oyster-shell, C. H. Slicer ... 213,460
Locomotives, variable exhaust for, E. R. Addison ... 213,311
Mail-bags, device for receiving and delivering, J. Southwick ... 213,463

Match-safe and candle-holder, combined pocket, F. A. Farrell... 213,406
Metals, coating, A. B. and W. P. Brown... 213,319
Middlings-separator, W. H. Forman and M. F. Williams... 213,328
Miller's proof-staff and red-staff, T. M. Logan... 213,339
Mowing-machine, hand, G. W. Jennings (reissue). 8,630
Mucilage holder and distributer, H. S. Carley... 213,385
Musical instrument, mechanical, O. H. Needham. 213,442
Musical instrument, mechanical, E. P. Needham. 213,443
Mustache cup and glass, A. Schenck... 213,455
Nose-bag for horses, E. J. B. Whitaker... 2 3,478
Nozzle, noise-quieting, T. Shaw... 213,302
Nut-lock, E. C. Smith... 213,354
Ores, machinery for separating, H. Hochstrate... 213,421
Packing, piston-rod, L. Saylor... 213,301
Padlock, C. W. A. Romer... 213,300
Pattern-plate for drafting garments, adjustable, A. McDowell... 213,436
Petroleum, apparatus for rectifying, J. Daul... 213,395
Picture-frame, H. Pattberg... 213,344
Pill feeder and counter, A. F. W. and W. F. A. Neynaber... 213,296
Pillow, mattress, etc., ventilated, M. P. R. Tilton. 213,360
Planter, corn, A. B. Dick... 213,397
Planter, seed, S. C. Knight... 213,430
Planters, check-rower for corn, E. W. Quincey... 213,449
Plough, G. L. Gifford... 213,410
Plough, C. W. Twigg... 213,475
Plug, safety, F. Lunkenheimer... 213,292
Poke, animal, W. H. Kretsinger... 213,432
Portable bath, W. McClure... 213,340
Printing, photo-chemical, W. Willis, Jr... 213,484
Puddling gas-furnace, revolving, S. Godfrey and R. Howson... 213,330
Pump, T. Dowling... 213,281
Pump, W. C. Wilcox... 213,309
Pump for vessels, bilge, J. Rilatt... 213,450
Pump, oil, E. Rew... 213.346
Pump or engine, portable, D. Bickford... 213,276
Pump, windmill, G. M. Beard... 213.314
Punching-press, F. Ecaubert... 213,326
Railway-switch, H. Douglass... 213,325
Railway-switch, B. Rice... 213,347
Refrigerating and making ice, apparatus for, J. G. Wolf... 213,487
Rein-check, H. W. Wilson, G. J. Birnbaum, and O. Hanks... 213,485
Root and stump puller, J. G. Trump... 213,473
Rotary engine and pump, A. Vacherot... 213,476
Rotative furnace lining, C. W. Siemens... 213,353
Sad-iron, J. Braun... 213,317
Saddle, riding, W. M. Herring... 213,418
Safe, fire and burglar-proof, S. A. Wilkins... 213,483
Salt from its solution, process and apparatus for separating common, L. Bemelmans... 213,381
Sash holder and lock, E. Homrighous... 213,331
Saw, circular, W. P. Miller... 213,439
Saw-gummer, S. H. Stepp... 213,304
Scale-beam, A. A. Houghton... 213.332
Scale-beam, A. A. Houghton... 213,423
Scow, Dumping, T. T. Church and A. Stillwell.. 213,387
Semolino, etc., machine for cleaning and sorting, C. Haggenmacher... 213,284
Sewer-pipe and trap, G. Cornwall... 213,394
Sewing covered nuts, machine for, L. T. Smith.. 213,462
Sewing-machine, button-hole, S. Cleminshaw... 213,391
Sewing-machine looping attachment, A. W. Cochran... 213,393
Sewing-machine treadle, O. H. Taylor... 213.359
Shafts, device for the lateral adjustment of, J. W. Yeo... 213,310
Shingling-bracket, J. L. Rogers... 213,349
Shovels, spades, and scoops, handle-socket for, P. W. Groom... 213,414
Shutter, G. W. Morstatt... 213,343
Sign, open, J. A. Hughes and C. R. Risdon... 213,426
Sled, L. R. Dexter... 213,396
Smoke-stack, locomotive, J. R. Fish... 213,407
Soldering-machine, J. W. Miller and B. Coll... 213,438
Speed-indicator for shafts, G. W. Storer... 213,467
Stamp, cancelling, A. Hughes... 213,333
Stamp-mills, ore-feeder for, D. H. Anderson... 213,373
Starch, manufacturing, G. Burkhardt... 213,320
Steam-boiler, W. Hopkins... 213,422
Steam-boilers, muffler for, F. W. Richardson... 213,348
Stockinet-seaming machine, J. A. Parr... 213,298
Stove-back lining, R. D. Sandiland... 213,352
Stove, heating, C. H. Speed... 213,465
Sun-helmet, H. Halvorson... 213,415
Tablet, artist's, H. Russell... 213,454
Telegraph-conductor, J. T. Shuster... 213,458
Telegraph-key, H. Ames... 213,312
Telephone, speaking, W. Gillett... 213,283
Tenoning-machine, G. H. Gregory... 213,413
Testing-machine, J. H. Usher... 213,362
Thill-coupling, L. Harris... 213,416
Thill-coupling, R. Houghtaling... 213,424
Thill-coupling, M. L. Winans... 213,486
Tire-tightener, W. P. Goolman... 213,412
Toaster and broiler, H. W. Seaman... 213,456
Toilet-case, J. S. White... 213,478
Tongs, pipe, H. Banister and C. H. Lovrien... 213,376
Toy, E. P. Roberts... 213,451
Trunk, A. J. Walrath... 213,308
Tube-cutter, T. Mamer and F. J. Wallerius... 213,293
Tube-expander, D. Bushor... 213,321
Umbrella crown-piece, C. A. Howard... 213,286
Upholstering-tuft, R. H. Bryant... 213.277
Upholstery, stuffing for, W. Phillips... 213,446
Valve-gear, steam engine, A. S. Cameron... 213,435
Valve, pressure-regulating, W. D. Dickey... 213,398
Varnish, J. D. Meigher... 213,342
Vehicle, side-bar, J. C. Walter... 213.477
Vehicle-spring, O. S. Carvill... 213,386
Vehicle-spring, W. H. Stickle... 213,466
Vehicle-step cover, W. Mellon... 213,437
Vehicle-wheel, D. Ottinger... 213,297
Violin tail-piece, M. A. Perrigo... 213,345
Wagon-bodies, bed-plate for, T. A. Frakes... 213,408
Wagon-brake, J. F. Ditsworth... 213,400
Wagons, dump for elevating and unloading, E. D. Harrison... 213,285
Wash-board, J. H. Lapham... 213,290
Watch movement box, H. J. Weston... 213,365
Water-closet, H. H. Craigie (reissue)... 8,626
Water-closet valve, J. Demarest... 213,324
Window-ventilator, A. Lammert... 213,337
Wire-coiling machine, L. Wildermuth... 213.482
Yoke attachment, neck, L. E. Ainsworth... 213,368

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